нитного поля. Подобные установки, основанные на ЯМР, используются в национальных метрологических институтах ряда европейских стран.

В основе передачи магнитных единиц магнитным материалам лежит воспроизведение магнитного поля в электромагните, в которое помещается образец магнитного материала, и измерение характеристик образца.

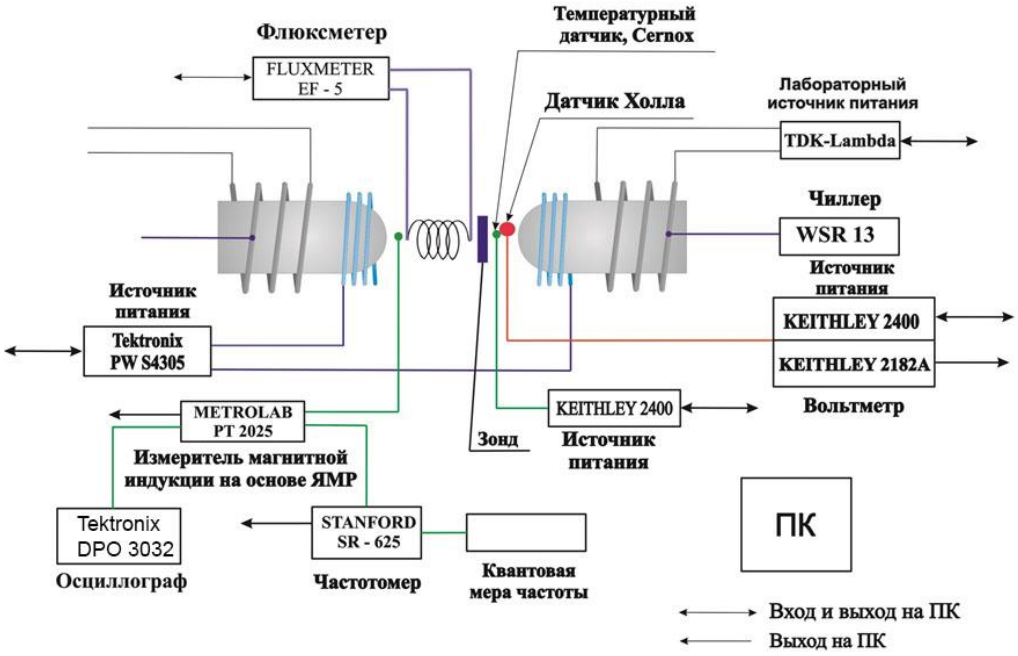

Рис. 1. Структурная схема установки

Разрабатываемый эталон в комплексе со стандартными образцами утвержденных типов позволит решить проблему метрологического обеспечения магнитоизмерительных установок, применяемых для измерения свойств магнитных материалов.

В докладе будет подробно рассказано о средствах измерений, входящих в состав установки и особенностях функционирования установки, а также приведены ее метрологические и технические характеристики.

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USAGE OF LOWPASS FILTERS FOR MINIATURIZATION OF MICROSTRIP BRANCH-LINE HYBRID COUPLERS

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One of the important trends today is the reduction of the geometric dimensions of microstrip devices. Many researches provide information on the use of a number of

methods of the size reduction of microstrip hybrid branch-line couplers. Chun et al used lumped-distributed elements (open stubs) to obtain smaller sizes [1], while Jung et al in [2] and [3] transformed lines with distributed capacitors to use the inner area effectively. Recent authors' investigations also covered aspects of the design of small conventional microstrip branch-line couplers [4, 5].

As a reference structure for miniaturization one of the most common types of branch-line hybrid couplers was chosen. It consists of two 35 Ohm transmission lines interconnected with 35 Ohm line in the middle and two 120 Ohm stubs at both ends of the structure at the same distance from the center. All lines should have the same phase response 90°.

The entire process of miniaturization consists of the replacement of the microstrip line with its equivalent in the form of a LPF with a 90° phase difference at the central operating frequency. The proposed design is implemented on a substrate with a dielectric constant $\varepsilon = 4.4$, dielectric loss tangent $tg\delta = 0.02$ and thickness h = 1 mm with solid ground layer on the bottom.

As a result of this research, it was found that the dimensions of the resulting design are 41% less than of the conventional branch-line coupler and 66% less than of the conventional hybrid coupler.

Comparison of parameters of miniaturized hybrid coupler and the conventional one

Design and technological implementation	**Area, mm2**	**Bandwidth with the isolation level of -20 dB, MHz**	**Phase difference**	**Transmission coefficient**	
				S_{31}	S_{41}
Conventional branch-line hybrid coupler	1089.5	662	90.37	-3.55	-3.48
Conventional branch-line coupler	627.08	223	90.24	-3.46	-3.49
Proposed coupler with 3rd order LPF	370.45	695	89.65	-3.77	-3.4

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